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GUIDELINES FOR THE BUREAU OF LAND MANAGEMENT IN THE USE OF THE BIBLIOGRAPHY ON THE EFFECT OF NOISE ON NON-HUMAN VERTEBRATES

by

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PURPOSE

The original purpose of the Bibliography on the Effect of Noise on Non-Human Vertebrates was to present the Bureau of Land Management an analyzed list of references concerning the known effects of noise on vertebrate animals, excluding humans. The present work, however, surpasses the original intent by encompassing information on a broad range of topics related to noise effects on vertebrates. In addition to the specific information requested by the Bureau of Land Management, pertinent data concerning; noise pollution and control, noise data measurements and summaries, sonic boom, noise use in pest control, acoustical characteristics, biocommunication, and auditory production and reception by animals are also included. Thus, this bibliography comprises a general document of use in facilitating literature searches involving the various aspects of acoustical phenomena and their relation to animals.

Specific references of interest to the Bureau of Land Management are listed below. They serve to direct attention to information pertaining to three major areas of concern; land management, effects of noise on vertebrates, and published sources of noise data.

LAND MANAGEMENT

Use of Public Lands	Reference
Arid Lands:	1, 2071
Land Use:	2505-8
-and aircraft Noise:	167, 190
Outdoor Use of Public Lands:	1152, 1737, 2549
Studies in the Environment:	2545-9
Noise and Land Management	
Ambient Noise, Wyoming:	493
Application of Animal Data for Noise Standards:	1370

Noise and Land Management (cont.)

International Noise Conference:	1718
Leisure Time Product Noise:	2254
Logging Noise:	943-4
Noise Effects on People:	2221
Noise Effects on Wildlife:	2222
Plants Used as Noise Buffers:	60, 87

Motor Vehicles and Ecological Effects

Vehicle Noise:	1211, 1215
-Control:	1590, 2351 (Motorcycles)
Off-Road Vehicles:	92, 269, 2327 Cape Cod: 517
-Effects on Desert:	139, 825, 1274, 2441
-Flora:	376, 697
-Fauna:	43, 177, 237-8
-Soil:	1029, 1418
-Snowmobiles	1405 (Minnesota Ecology)

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The publications concerning Arid Lands, Outdoor Use of Public Lands, and Studies in the Environment-Volume V- "Outdoor Recreation and Environment" (#2549) are of special value in that they present critical information regarding land management policies. The publications concerning Application of Animal Data for Noise Standards (#1370), Noise Effects on People (#2221) and Wildlife (#2222), and the Use of Plants as Noise Buffers (#60, 87) are useful for the information provided concerning the specific effects of noise and the reduction of those effects. The important aspects of motor vehicle effects on the environment are contained in Vehicle Noise Control (#1590), particularly motorcycle noise control (#2351). General effects of Off-Road Vehicles (#92, 269, 2327)

including a report on the sensitivity of coastal vegetation at Cape Cod to off-road vehicle impact are also of specific interest in that they present data concerning the effects of off-road vehicles on delicate habitats. Finally, the publications concerning the effects of off-road vehicles on the California deserts (#139, 825, 1274, 2441) including floral destruction (#376, 687), faunal impact (#43, 177, 237-8) and soil erosion (#1029, 1418) are of large importance in showing the effects of off-road vehicles on the desert ecosystems.

These aforementioned publications are identified as those of primary concern to the Bureau of Land Management in determining future land-use policies, especially those concerning wilderness areas. A particularly important reference concerning the present controversy of off-road vehicles and their impact on the delicate ecosystems of the California deserts is R. C. Stebbins', "Off-Road Vehicles and the Fragile Desert," (#1274), which presents an excellent summary and analysis of the complex problems arising from the use of wilderness areas as multi-purpose lands.

EFFECTS OF NOISE ON VERTEBRATES

Noise	References
General Effects:	82, 111, 267, 515, 655, 763, 810, 814, 928, 1327-8, 1872-3, 1890, 2137, 2221, 2300, 2309, 2358, 2370
-On Farm Animals:	29, 172, 174, 270, 706, 1269, 1881, 1946
-On Lab Animals; Guinea Pigs and Chinchillas:	108-10, 283-4, 328, 362, 368-72, 524, 572, 618-9, 836, 892, 1038, 1170, 1409-12, 1504
-On Fetal Development:	36, 50, 79, 728-9, 1198
-On Energy Metabolism:	95-6, 171, 173, 175
-On the Ear:	99, 162-3, 165, 307, 406, 474, 518-9, 608-10, 640, 740, 837, 962, 1069, 1088, 1090, 1233, 1253, 1266, 1288, 1292, 1315, 1348, 1377

Noise

General Effects (cont.)

-On the Brain:	17-20, 500, 803, 1318-23, 1324-5, 1845
-EEG:	800, 1220
-On the Nervous System:	78, 666, 918-20, 1231, 1330
-On Behavior:	200, 203, 420, 851, 866-7, 888, 934, 952, 1112, 1258, 1399
-On Sleep:	826, 1115, 1251, 1349, 2129, 2180, 2242, 2298, 2311, 2328
Psychological Effects:	222, 759-60, 769, 1037
Biochemical Effects:	123, 801, 834-5, 841, 906-8, 939, 947-9, 1015, 1071, 1079, 1100, 1116, 1171, 1184, 1262, 1273, 1347, 1371
Hearing Loss:	143, 177, 188, 265-6, 275-89, 290-4, 365, 368-72 382, 476, 581, 583-6, 590, 670-1, 765, 768, 829-830, 879, 891, 898-9. 902-3, 927, 999, 1018, 113 1135, 1038, 1053, 1057-60, 1072, 1090, 1124-6, 1167, 1169, 1172, 1175, 1219, 1275, 1278-9, 1366 1489, 1496, 1638, 2170, 2183
Non-Auditory Effects:	155, 176, 179, 249-51, 381, 441, 591, 669, 699, 764, 786, 886, 1011-2, 1047, 1174, 1227, 1291, 1566-7, 2182, 2243
Noise in Pest Control:	153, 216, 244, 316, 355, 453-4, 457-61, 463-4, 466-7, 537, 631, 719, 732, 784, 857,1030, 1267, 1350

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While the bibliography contains more numerous citations of noise effects on animals, only those dealing with specific effects of noise on terrestrial vertebrates have been listed above. Thus, combined effects of noise with other variables (heat, stress, shock, age, sex, etc.) and noise effects on fish and invertebrates have generally not been included above.

The above list represents an extensive documentation of the associated effects of noise on the well-being of vertebrates. This evidence, gathered from a wide range of vertebrates, suggests that noise exposures of sufficient intensity

over both short- and long-term durations have predictable, deleterious effects on organisms of every vertebrate class. Moreover, noise affects animals in both auditory and non-auditory ways. These effects include behavioral, physiological, and anatomical alterations and show detrimental changes in hearing capabilities (#765), energy metabolism (#95), and sleep patterns (#1349), to name only a few. Destruction of microscopic and gross anatomical structures is also documented (#406).

The use of noise as an agent for pest control is also worthy of examination. Several of these references specifically involved the use of noise as an aversive stimulus to frighten and dispel rodent (#355, 467, 537, 719, 857, 1267) and bird (#153, 216, 244, 463, 784, 1030, 1350) populations. The use of noise to effectively disperse undesired animal populations from offensive areas (airports and grain silos) suggests that other noises of similar intensities may likewise act to disperse wildlife populations from natural areas (i.e. Jet aircraft noise, explosions, gunfire, or massed off-road vehicles may possibly frighten and disperse native rodent and bird populations from previously quiet desert habitats).

Publications not cited above, all of which the Bureau of Land Management should be made aware, include many references concerning the hearing sensitivities of fish, amphibians, reptiles, birds, and mammals. (Particular attention is drawn to the works involving desert reptiles by Y. L. Werner and E. G. Wever, #1434-1476) Special note is made to references on the superior hearing abilities of owls (#533, 569, 746-7, 1024-5, 1102) and kangaroo rats (#716, 1151, 1387, 1420-7). The extreme importance of this sensory capability to the survival of each organism is concisely reviewed in articles by M. Konishi (#746-7), R. S. Payne (#1024-5) and D. B. Webster and M. Webster (#1426). The importance of auditory recognition of predators by prey populations is aptly summarized by L. Miller (#893).

The Bureau of Land Management, in considering the importance of the effects of noise on vertebrates should take special note of the abovementioned articles. The relative quiet of wilderness regions, hearing acuity of vertebrates, deleterious effects of noise on all types of animals, dispersal of animal populations by noise, and the importance of auditory reception to both predator and prey alike should be considered prior to the setting of noise standards or the opening or closing of wilderness areas to future development.

NOISE DATA SOURCES

Noise Research

Predicting Noise:	1651, 1713-5, 1971, 2093
Noise Models:	38, 2018
Noise Monitors:	1648-9, 2431
Noise Pollution:	338, 343, 2297, 2313, 2557
Noise Masking of Signals:	288, 298-9, 350, 513, 532, 795, 823, 864, 912, 1049, 1238-9, 1415, 2141, 2330
Desert Noise Surveys:	502-4, 1698
Aircraft Noise:	773, 1052, 1634, 1663-4, 1681, 1690-6, 1773, 1775, 1808, 1834, 1880, 1996, 1968, 2334
Jet Noise:	773, 1052, 1742, 1779-80, 1821, 1938, 2014, 2040, 2105, 2219, 2261-2, 2282, 2362
Helicopter Noise:	672, 1583, 1944, 2083, 2126-7, 2143, 2209, 2257, 2268, 2341, 2344
Sonic Boom:	117, 306, 332, 762, 828, 1117, 1153, 1413, 1416, 1419, 1516, 1544-6, 1660, 1734, 1743, 1907, 1952, 1955, 1959, 1986, 2005-6, 2039, 2091, 2104, 2120, 2302, 2308, 2409, 2117
-Startle Effects:	1344-5, 1398, 2085, 2347
-Measurements:	1667, 1685, 1735, 1859-60, 1879, 1903, 1969, 1974-5, 1993, 2012, 2028, 2037, 2049-50, 2053, 2057, 2064, 2073, 2088, 2128, 2139-40, 2144, 2227-8, 2263, 2326, 2329, 2356-8, 2360, 2439
Rocket Noise:	1686, 1904, 1953, 2029, 2252, 2293

Noise Research (cont.)

Airport Noise:	1549, 2045
-Ground Crews:	1683, 1877-8, 1924 Aircrews: 2333
Atmospheric Attenuation:	1561-2, 1770, 1989, 2048, 2301
Explosions:	1930, 1981, 2107, 2339, 2345
Firearms:	1687
Pneumatic Drills:	1677, 1954
Highway Noise:	1637, 1709, 2280, 2428
Truck Noise:	1652, 1727, 1749-50, 1763-4, 2343, 2380-5, 2403, 2408, 2422-4
Army Material:	2312
Motorcycle Noise:	1247
Snowmobile Noise:	275, 638, 2355, 2389
Construction Noise:	1679, 2223, 2283, 2316
Railroad Noise:	1671, 1727, 1763-4
Transmission Line Noise:	1774

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The above listings are of special interest to the Bureau of Land Management in that many of them provide a source of readily available data concerning noise levels that occur in public lands. Especially noteworthy are the five noise surveys performed to determine background noise levels in the desert (#502-4, 1698, 1808). Sonic boom and sound measurements have been taken for a variety of supersonic aircraft maneuvering at varying velocities and altitudes. Principal among these studies are those of D. J. Maglieri et al (#1859-60, 1879, 1903, 1974-5, 2028, 2057, 2073, 2128, 2329) and J. O. Powers et al (#2139-40, 2263). Of special interest are the sonic boom measurements and sound spectrographs taken at Edwards Air Force Base, California, (#2057, 2064, 2326). In addition, a number of "startle" effects of sonic boom have been documented for both

human and bird subjects (#1344-5, 1398, 2085, 2347, 2358, 2360, 2370). Among the most relevent of these articles are those of K. D. Kryter et al (#759-60, 762, 769). Noise data have been taken for helicopters, rockets, V/STOL aircraft, and also for explosions, including nuclear detonations (#2107), firearms discharge and rock drilling (#1677, 1687, 1954). The important aspects of the attenuation of such noises in the atmosphere are also represented, including noteworthy references concerning the effects of temperature, humidity and distance on sound attenuation. A selection of references dealing with techniques for the prediction and monitoring of noise data have also been included as has an article on construction of models pertaining to the understanding of noise phenomena. From such techniques, the Bureau of Land Management may be able to project trends concerning possible impacts of noise on wilderness areas.

A large amount of material exists concerning vehicle noise. The measurements include data for trucks, motorcycles, snowmobiles, construction equipment, and railroad noise. Other references include data relating to the masking of auditory signals by noise and noise measurements of high voltage transmission lines.

The Bureau of Land Management therefore has access to a number of already published sources which include surveys, maps, measurements, analyses, and characteristics of sounds that occur in the public lands under their administration. Data for aircraft, vehicles, explosions, gunfire, drilling, construction, and transmission line noise are all of concern to the Bureau of Land Management, and are all represented in the above documents. It is strongly suggested that the above references by thoroughly examined for their content prior to the collection of baseline data by the Bureau of Land Management. In many cases, it appears that only supportive data need be gathered in order to verify or modify these pre-existing reports. This would allow the Bureau of

Land Management to take full advantage of thispreviously compiled information sound in the environment, in order to more effectively understand and deal with this complex subject.

SUMMARY

In conclusion, these guidelines should allow the Bureau of Land Management to effectively use the Bibliography on the Effects of Noise on Non-Human Vertebrates to aid in their understanding of the complex problems involved in land management with regard to noise effects on animals and the natural sounds that occur in public lands. In this respect, the Bureau of Land Management is charged with an important task, that of deciding which public lands should be opened for future development, with its many ramifications, and which lands should remain closed. Owing to the great importance of decisions of this nature, it is highly recommended that prior to any critical decision involving an "environmental trade-off", exactly what is being "traded-off" and the degree of the "trade-off" be made publically known.

This series of guidelines and the bibliography to which they apply represent an effort to inform the Bureau of Land Management of the most critical information known concerning the effects of noise on vertebrate animals. In this manner, this report represents an assessment of the noise literature to date. It does not, however, seek to represent an assessment of the importance of a quiet habitat to both human and non-human vertebrates alike. The value of quiet wilderness areas, to both the native animals that occupy them and the humans that retreat to them is not mentioned in this report. In this respect, the absolute value of a quiet environment can never be known, only appreciated. The relative value of a quiet environment, however, is strongly implied, as evidenced by many articles in this report. It is earnestly hoped that the Bureau of Land Management will appreciate the relative importance of quiet habitats in future decisions involving these natural wilderness regions.

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Report to the Bureau of Land Management

BIBLIOGRAPHY ON THE EFFECT OF NOISE ON NON-HUMAN VERTEBRATES

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SYNOPSIS

This bibliography represents a comprehensive review of noise, sound and their effects on non-human vertebrates. There are 2568 references listed; 1-1523 from non-federal sources; 1524-1765 from the National Technical Information Service (NTIS); 1766-2568 from U. S. Government Publications. The major non-human effects are indexed under NOISE, Anatomical Effects (81 items); NOISE, Behavioral Effects (127 items); and NOISE, Physiological Effects (249 items). Other important noise references have not been overlooked. These include comprehensive reviews of Aircraft Noise and Sonic Boom, Noise Pollution, Noise Pollution Control, Motor Vehicle Noise, Methodology, Legal Aspects of Noise and Proceedings and Reports concerning noise. The subject of sound and its important bioacoustical aspects has also been cited. These citations include Bioacoustics, communication, echolocation, hearing, ultrasonics and infrasonics. The general physiology, anatomy and behavior of animals with respect to acoustic reception have also been cited. Finally, acoustical data books and characteristics have been referenced.

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